REMARKS/ARGUMENTS

Claims 1-46 were pending. Claims 1, 28, 31-34, and 37 have been amended. Claims 47 and 48 have been added. Accordingly, claims 1-48 presently are pending.

Claims 1, 31, 35, and 36 stand rejected under 35 U.S.C. § 102(b) as being anticipated by JP A 8-272980 in the name of Tsukasaki et al. Claim 32 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsukasaki et al. Claims 43 and 45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsukasaki et al. in view of U.S. Pat. No. 5,142,592 to Moler. Claims 2, 5, 10, 19-22, 28-30, 33, and 34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsukasaki et al. in view of U.S. Pat. No. 6,292,582 to Lin et al. Claim 44 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Lin et al., further in view of Moler. Claims 3, 7, and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of U.S. Pat. No. 5093869 to Alves et al. Claims 4, 9, 16, and 37-40 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Alves et al., further in view of Lin et al. Claim 46 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Alves et al., further in view of Lin et al., and further in view of Moler. Claims 11-15 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of U.S. Pat. No. 5,898,440 to Tachibana. Claims 17, 18, 24, and 25 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of U.S. Pat. No. 5,926,557 to King et al. Claims 23, 26, 27, and 41 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Alves et al. and Lin et al., and further in view of King et al. Claim 42 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Alves et al. and Lin et al., and further in view of Tachibana. Claim 6 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Tsukasaki et al. in view of Williams et al. Applicant respectfully traverses these rejections.

The present invention as recited in claim 1 is an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level

gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means."

Tsukasaki discloses a closed area extracting device in which edge detection is used to judge whether each pixel is an edge. The edge is designated as having one of four directions, and an adjacent pixel located in the direction of the edge is extracted. The adjacent pixel is deemed to be within the closed area. Tsukasaki does not teach or suggest an image processing apparatus that includes "line segment formation means for producing line segment image date representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." The Examiner asserts that Tsukasaki discloses "a register in the direction of the edge is turned on" and that the register corresponds to the line segment formation means and the line segment image storage means of claim 1. Applicant respectfully disagrees. The line segment formation means disclosed in the present application is a CPU which determines the direction and the length of the line segment image. By contrast, the registers disclosed by Tsukasaki simply store one of four directions for the edge pixel, the direction having been designated by edge detection part, for the purpose of locating one of four adjacent pixels. The register does not produce a line segment, and does not produce "line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means." Further, the registers disclosed by Tsukasaki do not store "the line segment image data produced by said line segment formation means." As noted above, the register simply stores one of four directions designated for the edge pixel. The abstract of Tsukasaki does not disclose a register, and

does not disclose that the register stores line segment image data. The registers disclosed by Tsukasaki do not correspond to the line segment formation means and line segment storage means which produce and store, respectively, "line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means." Claim 1 is patentable over Tsukasaki.

Alves et al. does not cure the deficiencies of Tsukasaki. Alves et al. discloses a scene recognition system in which regions are analyzed for linear segments. Alves et al. does not teach or suggest an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 3, 7, and 8 are patentable over the cited prior art.

Lin et al. does not cure the deficiencies of Tsukasaki or Alves et al. Lin et al. discloses an anomaly detecting system which uses a decomposition window to trace an outline of an image area. Tracing along a line segment continues until an end is detected, at which point start and end point data for the entire line segment is recorded. The line segment results from the decomposition of a plurality of pixels, and is not a line segment produced for each pixel or "processing unit" as recited in the claims of the present invention. Thus, Lin et al. does not teach or suggest an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to

the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 2, 5, 10, and 19-22 are patentable over the cited prior art.

King et al. does not cure the deficiencies of Tsukasaki, Alves et al., or Lin et al. King et al. discloses an inspection system in which a vector is placed across a reflected image element, and pixels along the vector are examined to determine a midpoint of each element. King et al. does not teach or suggest an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 17, 18, and 23-27 are patentable over the cited references.

Tachibana does not cure the deficiencies of Tsukasaki. Tachibana discloses a system for preventing aliasing in displayed graphics figures. Straight lines are plotted, and the intensity value of pixels is adjusted according to antialiasing conditions. Tachibana does not teach or suggest an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 11-15 are patentable over the cited references.

Moler does not cure the deficiencies of Tsukasaki. Moler discloses an image processing system for detecting parallel edges in an image. Edge detection is followed by minima detection and determinations of parallelism strength. Moler does not teach or suggest an image processing apparatus that includes "line segment formation means for producing line segment image date representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claim 43 is patentable over the cited references.

The present invention as recited in amended claim 28 is an image processing apparatus that includes "an image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "display means for displaying the line segment images represented by the line segment image data produced by said image processing means."

Tsukasaki discloses a closed area extracting device in which edge detection is used to judge whether each pixel is an edge. The edge is designated as having one of four directions, and an adjacent pixel located in the direction of the edge is deemed to be within the closed area. Tsukasaki does not teach or suggest an image processing apparatus that includes "an image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "display means for displaying the line segment images represented by the line segment image data produced by said image processing means."

Lin et al. does not cure the deficiencies of Tsukasaki. Lin et al. discloses a decomposition window used in an anomaly detecting system which traces an outline of an image area. Tracing along a line segment continues until an end is detected, at which point start and end point data for the line segment is recorded. Lin et al. does not teach or suggest an image processing apparatus that includes "an image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "display means for displaying the line segment images represented by the line segment image data produced by said image processing means." Claims 28-30 are patentable over the cited prior art.

Moler does not cure the deficiencies of Tsukasaki and Lin et al. Moler discloses an image processing system for detecting parallel edges in an image. Edge detection is followed by minima detection and determinations of parallelism strength. Moler does not teach or suggest "an image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "display means for displaying the line segment images represented by the line segment image data produced by said image processing means." Claim 44 is patentable over the cited prior art.

The present invention as recited in amended claim 31 is an image processing method including steps of "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level

gradient for each pixel having a non-zero level gradient," and "storing the produced line segment image data in storage means."

Tsukasaki discloses a closed area extracting method in which edge detection is used to judge whether each pixel is an edge. The edge is designated as having one of four directions, and an adjacent pixel located in the direction of the edge is deemed to be within the closed area. Registers disclosed by Tsukasaki simply store one of four directions for the edge pixel, the direction having been designated by an edge detection part, for the purpose of locating one of four adjacent pixels. Tsukasaki does not teach an image processing method including steps of "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "storing the produced line segment image data in storage means."" Claim 31 is patentable over Tsukasaki.

The present invention as recited in amended claim 32 is a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "store the produced line segment image data in storage means."

Tsukasaki discloses a closed area extracting method in which edge detection is used to judge whether each pixel is an edge, the edge being designated as having one of four directions. An adjacent pixel located in the direction of the edge is deemed to be within the closed area. Tsukasaki discloses storing one of four directions for the edge pixel, the direction having been designated by an edge detection part, for the purpose of locating

one of four adjacent pixels. Tsukasaki does not teach or suggest a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "store the produced line segment image data in storage means." Claim 32 is patentable over Tsukasaki.

The present invention as recited in amended claim 33 an image processing method that includes "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "displaying line segment images represented by the produced line segment image data on a display device."

Tsukasaki discloses a closed area extracting method in which edge detection is used to judge whether each pixel is an edge, the edge being designated as having one of four directions. An adjacent pixel located in the direction of the edge is deemed to be within the closed area. Tsukasaki discloses storing one of four directions for the edge pixel, the direction having been designated by an edge detection part, for the purpose of locating one of four adjacent pixels. Tsukasaki does not teach or suggest an image processing method that includes "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "displaying line segment images represented by the produced line segment image data on a display device."

Lin et al. does not cure the deficiencies of Tsukasaki. Lin et al. discloses a method of using a decomposition window in an anomaly detecting system to trace an outline of an image area. Tracing along a line segment continues until an end is detected, at which point start and end point data for the line segment is recorded. Lin et al. does not teach or suggest an image processing method that includes "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "displaying line segment images represented by the produced line segment image data on a display device." Claim 33 is patentable over Tsukasaki and Lin et al.

The present invention as recited in amended claim 34 is a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient for each of a plurality of processing units in given image data, and produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient," and "display line segment images represented by the produced line segment image data on a display device."

Tsukasaki discloses a closed area extracting method in which edge detection is used to judge whether each pixel is an edge, the edge being designated as having one of four directions. An adjacent pixel located in the direction of the edge is deemed to be within the closed area. Tsukasaki discloses storing one of four directions for the edge pixel, the direction having been designated by an edge detection part, for the purpose of locating one of four adjacent pixels. Tsukasaki does not teach or suggest a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient for each of a plurality of processing units in given image data, and produce line segment image data representing a line segment for each of the plurality of processing

units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient," and "display line segment images represented by the produced line segment image data on a display device."

Lin et al. does not cure the deficiencies of Tsukasaki. Lin et al. discloses a method of using a decomposition window in an anomaly detecting system to trace an outline of an image area. Tracing along a line segment continues until an end is detected, at which point start and end point data for the line segment is recorded. Lin et al. does not teach or suggest a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient for each of a plurality of processing units in given image data, and produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient," and "display line segment images represented by the produced line segment image data on a display device." Claim 34 is patentable over Tsukasaki and Lin et al.

The present invention as recited in claim 35 is an image processing apparatus that includes "means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data," "means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge," and "means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof."

Tsukasaki discloses a closed area extracting device in which edge detection is used to judge whether each pixel is an edge. The edge is designated as having one of four directions, and an adjacent pixel located in the direction of the edge is extracted. The adjacent pixel is deemed to be within the closed area. The Examiner asserts that means for setting a line segment is shown in Fig. 35 of Tsukasaki, and means for detecting the presence or absence of a point of intersection is shown in Fig. 50 of Tsukasaki. Applicant

notes that Fig. 35 discloses vectors, rather than line segments, and relates to the invention of Tsukasaki, whereas Fig. 50 relates to the separate prior art system discussed in the Tsukasaki document. Thus, Tsukasaki does not anticipate the present invention as recited in claim 35. Further, the invention of Tsukasaki teaches away from Fig. 50 of the prior art, so the required motivation does not exist for combining the prior art with the invention of Tsukasaki to arrive at the present invention for prima facie obviousness. Tsukasaki does not teach an image processing apparatus that includes "means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data," "means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge," and "means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof."

Moler does not cure the deficiencies of Tsukasaki. Moler discloses an image processing system for detecting parallel edges in an image. Edge detection is followed by minima detection and determinations of parallelism strength. Moler does not teach or suggest an image processing apparatus that includes "means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data," "means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge," and "means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof." Claims 35 and 45 are patentable over Tsukasaki and/or Moler.

The present invention as recited in amended claim 37 is an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are

concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Tsukasaki discloses a closed area extracting device in which edge detection is used to judge whether each pixel is an edge. The edge is designated as having one of four directions, and an adjacent pixel located in the direction of the edge is extracted. The adjacent pixel is deemed to be within the closed area. Tsukasaki does not teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Alves et al. does not cure the deficiencies of Tsukasaki. Alves et al. discloses a scene recognition system in which regions are analyzed for linear segments. Alves et al. does not teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Lin et al. does not cure the deficiencies of Tsukasaki and Alves et al. Lin et al. discloses an anomaly detecting system which uses a decomposition window to trace an outline of an image area. Tracing along a line segment continues until an end is detected, at which point start and end point data for the line segment is recorded. Lin et al. does not

teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

King et al. does not cure the deficiencies of Tsukasaki, Alves et al., or Lin et al. King et al. discloses an inspection system in which a vector is placed across a reflected image element, and pixels along the vector are examined to determine a midpoint of each element. King et al. does not teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Tachibana does not cure the deficiencies of Tsukasaki, Alves et al., and Lin et al. Tachibana discloses a system for preventing aliasing in displayed graphics figures. Straight lines are plotted, and the intensity value of pixels is adjusted according to antialiasing conditions. Tachibana does not teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting

the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Moler does not cure the deficiencies of Tsukasaki, Alves et al., or Lin et al. Moler discloses an image processing system for detecting parallel edges in an image. Edge detection is followed by minima detection and determinations of parallelism strength. Moler does not teach or suggest an inspection apparatus that includes "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data." Claim 37, and its dependent claims 38-42 and 46, are patentable over the cited prior art.

New claims 47 and 48 have been added. Dependent claim 47 recites that the image processing apparatus of claim 1 includes line segment image processing means for processing line segment image data stored in the line segment image storage means. Independent claim 48 recites subject matter of the invention without the use of means-plus-function language. The subject matter of claims 47 and 48 is patentable over the cited references.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

By _____

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